

Appendix F. Power Analysis for Oregon Caves National Monument Mist Netting Site.

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One measure of the efficacy of long-term monitoring is the ability to detect population trends. The power to detect trends should be balanced with other considerations of the monitoring program's performance (e.g., the value of demographic data, bird abundance relative to external variables [i.e., habitat and climate], and the contribution to other monitoring efforts). We present the results of a power analyses to help assess bird monitoring efforts at Oregon Caves National Monument. These analyses follow recommendations established by Bart et al. (2004), that population trend monitoring programs be designed to meet a standard of 80% power to detect 50% decline over 20 years at a significance level of 0.10. These results should be interpreted cautiously, recognizing the assumptions of trend and annual variance models and limitations associated with only four years of data. We conducted the power analysis using R version 2.5.1 (2007). Frey et al. (2007) previously reported methods and results for the banding program at Oregon Caves National Monument between 2002 and 2006.

We performed power analyses on five commonly captured species and determined the power to detect a 50% decline over 20 years at significance levels of 0.05 and 0.10 (Table 1). The power analysis incorporates four parameters: annual variance, desired trend, population abundance at year one (intercept of the model), and number of sample years. We log transformed the data to achieve a normal distribution. It is advantageous to transform the linear model data used in these analyses; the error is linear on a log scale (i.e., the error increases with the mean on the true scale) and when we fit a linear additive slope on a log scale, it is a multiplicative slope on the true scale. To quantify the variance, we fit a linear model with only an intercept term that provides the mean (intercept) and standard deviation (residual error) for the distribution. The annual variation (residual error) and population size (intercept) determine the power to detect trends.

Power analyses were conducted for a diverse set of species, season, and age combinations (Table 1). Annual relative abundance data for after hatch year birds provide a measure of population trends and hatch year birds provide annual measures of productivity. Breeding season abundance data provide annual measures for local populations; migration data provide annual measures for regional populations. We have sufficient power to detect trends for three species as recommended by Bart et al. (2004; 80% power to detect 50% decline over 20 years, $p \leq 0.10$). The same subset of species met the 80% cutoff at a significance level of 0.05. Data provide sufficient power to detect trends for local MacGillivray's Warbler and Dark-eyed Junco populations, local Dark-eyed Junco productivity, and regional Dark-eyed Junco and Hermit Thrush populations. This mist netting site will yield important trend information over time, as well as contribute to the trends generated by larger regional monitoring efforts conducted by the Klamath Bird Observatory.

Appendix F. Power Analysis for Oregon Caves National Monument Mist Netting Site (continued).

Table 1. Power analysis was performed on five species that are commonly caught at the Oregon Caves National Monument mist netting site to determine the power to detect a 50% decline over 20 years at $p \leq 0.05$ and 0.1. Results with power greater than or equal to 80% are highlighted.

Species, Season, and Age	Intercept	Residual Error	$P \leq 0.05$	$P \leq 0.10$
Chestnut-backed Chickadee				
Breeding season HY	-4.53	0.99	0.13	0.22
Breeding season AHY	-5.96	0.71	0.24	0.34
MacGillivray's Warbler				
Breeding season HY	-4.11	0.41	0.58	0.71
Breeding season AHY	-4.31	0.31	0.82	0.90
Dark-eyed (Oregon) Junco				
Breeding season HY	-3.30	0.22	0.98	0.99
Breeding season AHY	-3.14	0.29	0.88	0.93
Migration HY	-4.16	0.77	0.23	0.33
Migration AHY	-3.95	0.26	0.92	0.97
Red-breasted Nuthatch				
Breeding season HY	-5.00	0.95	0.15	0.26
Breeding season AHY	-6.17	0.65	0.29	0.40
Hermit Thrush				
Migration HY	-4.88	0.72	0.23	0.37
Migration AHY	-5.54	0.27	0.92	0.96

References

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